A Study of a Full Life Cycle Control Methodology for Digital Transformation in Adventure Sailing Enterprises

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Abstract. Digital transformation has become an important means for modern enterprises to enhance their competitiveness, especially in the context of globalization of competition, technological innovation and rapid market changes, and state-supported 'start-ups' face unique challenges and opportunities in the process of digital transformation. This paper proposes a full life-cycle control approach and system for digital transformation, aiming to help enterprises monitor, optimize and adjust various technical and management measures during the transformation process to achieve efficient digital transformation. The systematic lifecycle control approach helps startups improve productivity, innovation and resource utilization, and ensures continuous innovation and market responsiveness during the transformation process. The paper also explores key technology applications for digital transformation, including industrial internet, big data, artificial intelligence and cloud computing, providing theoretical guidance and practical frameworks for startups.

Keywords: Adventure Sailing Enterprises; digital transformation; full life cycle; control methods; technological innovation

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1 Introduction

With the rapid development of science and technology, digitalization has become a key force to drive the continuous growth and innovation of enterprises [1-3]. Especially under the impetus of SASAC's 'Adventure Sailing Enterprises' policy, many startups have begun to venture into high-tech fields such as artificial intelligence, quantum information, biomedicine, new energy, new materials, etc., challenging the boundaries of traditional industries and striving to take their place in the global emerging industries. Pioneer enterprises are selected by the State-owned Assets Supervision and Administration Commission of the State Council as key cultivation targets, aiming at nurturing startups with development potential and innovation ability into future 'unicorn' enterprises [4-5].

However, adventure sailing enterprises face many unique challenges and needs in the process of digital transformation[6-7]. Firstly, the digital transformation needs of 'sailing adventure' enterprises involve not only technology upgrades, but also organizational structure innovation, business process re-engineering, and employee competence enhancement. Secondly, 'sailing adventure' enterprises are usually small in scale and high in risk, and lack sufficient resources to carry out comprehensive digital transformation, so the control and guidance of digital transformation is particularly critical; finally, 'sailing adventure' enterprises often face high-risk markets, are in a high-risk environments and grow rapidly, there is an urgent need for a set of systematic, full life-cycle digital transformation control methods to ensure the success and stability of the transformation process.

Most traditional digital transformation programs are aimed at large, established enterprises and lack customized support for start-ups, especially the ability to adapt to high-risk, high-reward areas. As a result, existing digital transformation management approaches are difficult to meet the specific needs of adventure sailing companies in the transformation process.

In order to solve the above problems, this paper takes the medium- and long-term digital transformation planning of a new material as an opportunity, conducts benchmarking research on digital benchmarking enterprises in its field, combines the characteristics of start-ups, summarizes and refines the full life cycle management and control methodology system for the digital transformation of the sailing adventure company in terms of innovation drive, resource aggregation, risk control, market response, etc., and provides a comprehensive solution.

2 The Current Situation and Challenges of Digital Transformation in Adventure Sailing Enterprises

Driven by the global digital wave, digital transformation has become a key path for enterprises to enhance competitiveness and achieve sustainable development[8]. Especially in China, Adventure Sailing Enterprises, as the key state-supported enterprises selected by the State-owned Assets Supervision and Administration Commission (SASAC), occupy an important position in high-tech and high-growth industries. These

enterprises are widely distributed in the field of artificial intelligence, life science, green energy, aerospace and other cutting-edge technologies, with strong innovative potential and market development prospects. Taking a new material's medium- and long-term digital transformation plan as an opportunity, this paper conducts a benchmarking study on digital benchmarking enterprises in its field, and concludes that Sailing Adventure Enterprises still face many challenges in applying and implementing digital transformation, which come from both the technological level, as well as organizational, managerial and market factors.

2.1 The Current Situation of Digital Transformation in Adventure Sailing Enterprises

Most Adventure Sailing Enterprises have strong technological innovation capability and market expansion potential, but they generally face the following status quo in the actual digital transformation process:

(1) Relatively lagging behind in infrastructure development

Although many Adventure Sailing Enterprises have strong technological reserves in specific technological fields, their digital infrastructure such as data centers, cloud platforms and industrial internet is often inadequate. Many enterprises still rely on traditional IT architectures and lack flexible cloud computing platforms and data storage capabilities, leading to difficulties in technology deployment and slower transformation in the process of digital transformation.

(2) Fragmented and complex technology applications

Although Adventure Sailing Enterprises has accumulated a certain amount of emerging technology applications, the overall technology applications are still relatively dispersed. Different business departments within the enterprise (e.g., research and development, production, marketing, finance, etc.) tend to use their own independent technology platforms and tools, lack of unified data management and technology architecture, the formation of information silos, and the data can not be effectively shared and used collaboratively.

(3) Digital management system construction is not perfect

The digital management construction of Adventure Sailing Enterprises is still imperfect. Although some enterprises in the research and development, production and other areas of part of the digital transformation, but the overall digital management system and processes of the enterprise has not been fully optimized. Many enterprises in the finance, supply chain, quality control and other management areas still rely on manual operation or traditional software, and can not fully achieve intelligent, automated management.

(4) Lack of data-driven decision-making

Although big data technology has been widely used in various industries, most Adventure Sailing Enterprises have not yet established an effective data asset management and analysis platform to fully exploit the value of data. Enterprises' decision-making still relies on traditional experience and intuition, and lacks accurate decision-making support based on data and artificial intelligence, resulting in a slower response to market and technological changes.

(5) Talent Shortage and Skills Gap

Digital transformation is not only a change in technology, but also requires the transformation of corporate organizational culture, management mode and talent structure. However, during the transformation process, Adventure Sailing Enterprises generally face a shortage of high-end digital talent. Existing employees often lack sufficient digital knowledge and skills, especially in emerging areas such as data analysis, artificial intelligence algorithms, cloud computing, etc., and the supply of talent cannot meet the needs of corporate transformation.

2.2 Main Challenges Faced by Adventure Sailing Enterprises in Digital Transformation

Although Adventure Sailing Enterprises have certain development advantages under the support of national policies, they still face multiple challenges in the process of digital transformation. These challenges are not only reflected in the technical level, but also involve management, culture, market and other complex factors.

Challenges at the Technical Level. (1) Difficulty in technology selection.

Startups are usually faced with a variety of emerging technologies to choose from, such as artificial intelligence, IoT, blockchain, and big data, which often have different application scenarios, implementation costs, and maturity technology. How to make a suitable choice among the many technologies and integrate them with existing production systems and management models is a major challenge for enterprises in the transformation process. Many startups lack sufficient technology assessment capabilities, leading to biased technology selection and affecting transformation results.

(2) Difficulty in system integration

The business systems of Adventure Sailing Enterprises are complex and diverse, involving research and development, production, sales, supply chain and many other aspects. Integration between different systems is difficult, especially the compatibility between existing systems and emerging technology platforms, which often leads to increased complexity in the implementation of digital transformation. Incompatibility of technology platforms and non-uniformity of data interfaces may cause blockage of information flow, thus affecting the overall transformation progress.

(3) Data management and security issues

Data is a core asset of digital transformation, but data management and security issues are important topics that startups must face in the transformation process. Enterprises face legal compliance issues such as data security and privacy protection when collecting, storing, analyzing and sharing data. In addition, establishing an efficient data governance structure to ensure the quality and consistency of data is also a technical challenge for enterprises.

Challenges at the Management Level. (1) Lagging management mode

Adventure Sailing Enterprises tend to focus their attention on technology introduction and process optimization in the process of transformation, neglecting the

innovation of management mode. The traditional management thinking and models of enterprises often conflict with the concepts of flexibility and data-driven decision-making required by digital transformation. Many enterprises still rely on hierarchical and bureaucratic management in the process of digital transformation, and the lack of cross-departmental collaboration and information sharing has led to limited transformation effects.

(2) Digital culture cultivation lags behind

Digital transformation is not only a transformation of technology, but also a change in corporate culture. The management of Adventure Sailing Enterprises often lacks attention to the construction of digital culture, and employees lack sufficient participation and identification in the process of digital transformation. The internal division of labor within the enterprise is too traditional, and the staff's sense of innovation and technical application ability are relatively weak, which cannot fully mobilize the enthusiasm of the staff and affects the extensive landing of the transformation.

Resource Challenges. (1) Funding and investment risks

Although digital transformation of Adventure Sailing Enterprises is supported by policies, capital investment is still one of the core issues of enterprise transformation. Digital transformation often requires huge upfront investment, including hardware facilities, technology platform construction, and talent training. However, the effect of digital transformation often takes a long time to manifest itself, with great uncertainty, and enterprises are often difficult to accurately assess the return on investment, which makes capital investment an important obstacle.

(2) Insufficient supply of talents

The shortage of talent faced by Adventure Sailing Enterprises in the transformation process is particularly prominent. Although many enterprises have invested resources in the recruitment and training of digital talents, existing technical talents and managers often lack sufficient cross-disciplinary knowledge to provide comprehensive support in technology selection, system design, business process optimization and other aspects. In addition, the demand for talent in the process of digital transformation is not only limited to IT technical talent, but also requires composite talent with strategic thinking, data analysis and change management capabilities.

Market-Level Challenges. (1) Changes in Market Demand

During the transformation process, Adventure Sailing Enterprises also need to address the challenges posed by rapidly changing market demands and technological advances. The global market is changing rapidly, and consumer demands and technological advances are changing rapidly. In the process of promoting digital transformation, enterprises must always pay attention to market trends and react quickly to external changes. Enterprises that rely too heavily on traditional business models and production methods may miss market opportunities and affect their competitiveness.

(2) Increased competitive pressure

In the process of digital transformation, Adventure Sailing Enterprises not only have to compete with their domestic counterparts, but also face the pressure of globalized

competition. The international competition in science and technology innovation makes it necessary for startups to continuously improve their technological level, innovation capability and production efficiency in the process of transformation, or else it will be difficult for them to take their place in the global market.

3 Full life Cycle Control Methods for Digital Transformation of Adventure Sailing Enterprises

With the rapid changes in the global economy and the continuous progress of science and technology, digital transformation has become a necessary way for enterprises to stand out in fierce market competition. Especially as an entrepreneurial enterprise supported by the state, digital transformation is not only a need to improve technical capabilities, but also an important strategy to promote business innovation, optimize management efficiency and enhance market competitiveness. In order to ensure the success of digital transformation, this paper proposes a control methodology for the whole life cycle of digital transformation, with a specific process as shown in Figure 1, aiming to help enterprises ensure the efficient promotion and long-term success of digital transformation through the four phases of system planning and assessment, technology implementation and optimization, innovation and continuous optimization, and monitoring and adjustment.

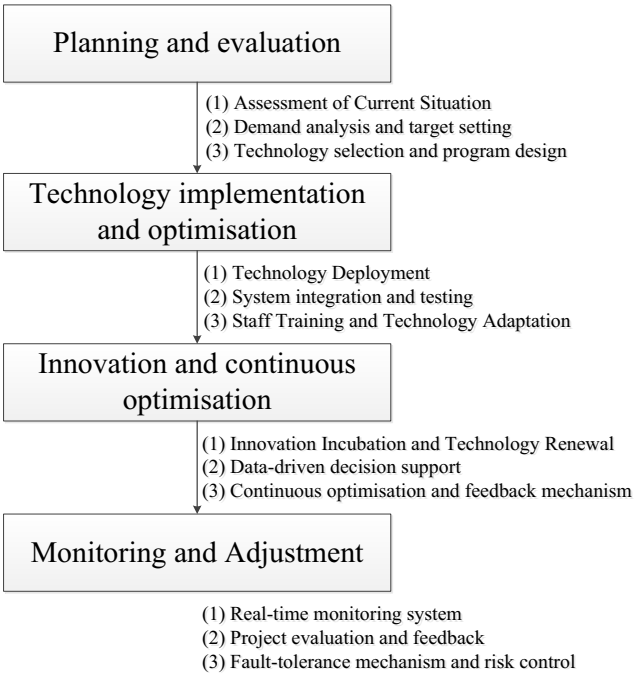

Fig. 1. The full lifecycle management and control methodology for digital transformation of Adventure Sailing Enterprises

3.1 Planning and Assessment Phase

The planning and assessment phase is the starting point of digital transformation [9-10], and the key steps include status quo assessment, demand analysis and goal setting, technology selection and schematic design. The core objective of this phase is to help enterprises clarify their transformation goals, identify current technology bottlenecks, and lay the foundation for subsequent technology selection and implementation schematic design.

(1) Status Assessment

Status assessment is the first step in digital transformation, which helps enterprises understand the degree of digitization of current business processes. Through data collection and analysis, enterprises can identify technical bottlenecks and management problems in production lines, R&D, supply chain, sales and financial management, whether there are inefficient links in production lines, lagging data and information in R&D, and lack of real-time data support in supply chain management. This assessment process provides an objective basis for subsequent demand analysis and technology selection.

(2) Demand analysis and target setting

Enterprises determine their short, medium and long-term goals for digital transformation through a comprehensive assessment of the current situation. Short-term goals usually focus on infrastructure construction, production line automation, etc.; medium-term goals may be the establishment of an intelligent R&D platform, a data-driven decision support system, etc.; and long-term goals may involve the construction of a globalized intelligent supply chain and a product lifecycle management platform. Goal setting at each stage needs to be highly aligned with the strategic direction of the enterprise to ensure that digital transformation can produce the expected economic benefits and technological breakthroughs at each stage.

(3) Technology selection and schematic design

According to the actual needs of enterprises, choosing the right digital technology platform is the key to successful transformation. Industrial Internet (IoT) platforms can help enterprises connect production equipment, collect data in real time, and achieve remote monitoring; cloud computing platforms can provide strong support for data storage and processing; big data and artificial intelligence technologies[11] can help enterprises improve production efficiency, optimize the R&D process, and accurately predict market demand. Enterprises also need to design specific implementation schematics based on their own technical capabilities and budgets to ensure that the various technologies can effectively work together to support the transformation goals.

3.2 Technology Implementation and Optimization Phase

After defining the goals and options for digital transformation in the planning and assessment phase, the enterprise enters the technology implementation and optimization phase. In this phase, the enterprise should focus on the actual deployment of the technology, system integration, testing and employee training to ensure that the technology is implemented, and value is maximized [12-13].

(1) Technology deployment

The enterprise deploys digital technology on the basis of preliminary planning, focusing on the implementation of intelligent upgrading in various areas such as production lines, R&D, supply chain and sales. By installing sensors and implementing Internet of Things (IoT) technology, enterprises can monitor the operating status of production equipment in real time, such as temperature, humidity, pressure and other key parameters. Through the cloud computing platform, enterprises can achieve real-time storage and analysis of data, providing support for decision makers in timely production scheduling and market response. In addition, the introduction of automated equipment and smart factory systems can help increase production efficiency, reduce labor costs and improve product quality.

(2) System integration and testing

After the technology deployment is completed, enterprises need to carry out system integration of various technologies to ensure that all aspects of digital technology can work together efficiently. The goal of system integration is to break down information silos and achieve data sharing and interoperability between different technology platforms. The integrated system needs to be simulated, tested and optimized to ensure that it can operate stably and perform as expected in real production. At this point, enterprises need to pay special attention to the scalability of the system to ensure that the existing system can support future expansion and upgrading in line with business growth and changing needs.

(3) Staff training and technology adaptation

Technology implementation depends not only on the deployment of systems and hardware, but also on the adaptability and technical skills of employees. Enterprises need to organize training for employees on systems and platforms to help them familiarize themselves with new workflows and digital tools, and to ensure that they are able to make full use of new technologies to improve efficiency and productivity. In addition, companies need to promote cultural transformation to make employees aware of the importance of digital transformation, inspire them to participate, and help them overcome barriers to technological adaptation during the transformation process.

3.3 Innovation and Continuous Optimization Phase

Digital transformation is not a one-time project, but a continuous evolutionary process. Entering the innovation and continuous optimization phase, companies need to continuously iterate and optimize their technologies in order to improve the adaptability of transformation outcomes, the market competitiveness of their products and the overall efficiency of the company [14-15].

(1) Innovation incubation and technology renewal

After the implementation stage, enterprises should establish innovation laboratories or technology R&D platforms to continuously promote technological innovation and product iteration and renewal through open innovation and cross-industry cooperation. Through cooperation with universities, research institutes and innovative enterprises, enterprises can obtain more technical support and resources, improve R&D efficiency and promote the incubation and application of new technologies. Enterprises can adopt

artificial intelligence and machine learning to optimize production processes, develop new composite materials or intelligent supply chain management systems.

(2) Data-driven decision support

Enterprises collect and analyze large amounts of production data, market data and financial data through data analytics platforms to help decision makers make more accurate and timely decisions. Big data analytics and artificial intelligence technologies can provide enterprises with real-time decision support such as market demand forecasting, production scheduling optimization and risk early warning. Data-based decision support systems can not only improve the reaction speed of enterprises, but also reduce human decision-making errors, helping enterprises to remain competitive in the rapidly changing market.

(3) Continuous optimization and feedback mechanism

The implementation effect of digital transformation requires continuous assessment and adjustment. Enterprises should establish a cyclical assessment mechanism to optimize technical applications and management processes in a timely manner based on market feedback, technological progress and changes in business requirements. Through continuous optimization, enterprises can continuously improve the adaptability of the digital system, ensure that the various technical applications in the transformation process achieve the expected results, and continuously promote the maximization of transformation results.

3.4 Monitoring and Adjustment Phase

The monitoring and adjustment phase is a key part of the digital transformation process, which helps enterprises track the progress of transformation, identify problems and make timely adjustments [16-17].

(1) Real-time monitoring system

Enterprises need to deploy a perfect digital monitoring system to collect and analyze real-time data from production, R&D, supply chain and other links. These data can help enterprises discover abnormalities in the production process in a timely manner and make adjustments through automated systems to avoid production accidents and resource wastage. In addition, the monitoring system can provide real-time feedback on key business indicators, helping top management make more accurate decisions when making strategic adjustments.

(2) Project Evaluation and Feedback

Digital transformation is a dynamic process, and enterprises need to ensure that the objectives of each stage are achieved through stage-by-stage evaluation and feedback and provide a basis for the work of subsequent stages. Through project evaluation, enterprises can adjust resource allocation, optimize technical solutions and strategic direction in a timely manner to ensure that the effect of digital transformation is maximized, and the expected strategic objectives are achieved.

(3) Fault-tolerance mechanism and risk control

A fault-tolerance mechanism is very important in the process of innovation and technology implementation. Enterprises should allow a moderate degree of trial and error and encourage technology teams to continuously experiment and innovate. At the same

time, enterprises should also strengthen risk control, especially in the process of technology updating and cross-functional collaboration, so as to identify potential technology, market and management risks in a timely manner and take effective measures to deal with them.

4 Digital Transformation Full Life Cycle Control System Design

In order to achieve full lifecycle control of digital transformation for Adventure Sailing Enterprises, this paper designs an integrated control system that aims to ensure that companies can implement digital transformation efficiently and accurately, with real-time tracking, adjustments and optimization at all stages. Figure 2 illustrates the five functional modules covered by the system, namely the demand analysis module, the technology selection and solution design module, the real-time monitoring and evaluation module, the decision support and optimization module, and the innovation incubation and collaboration module. Together, these modules will drive the full implementation and continuous optimization of the enterprise's digital transformation.

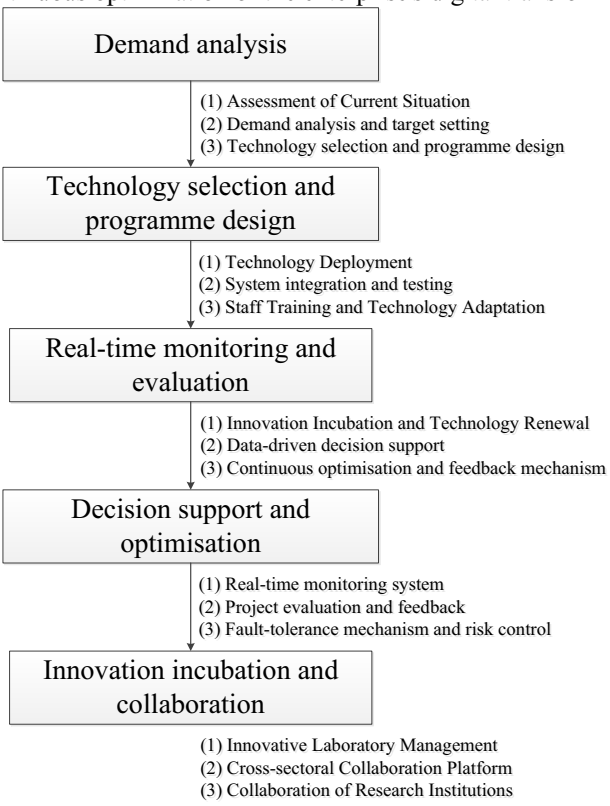

Fig. 2. Digital Total Life Cycle Control System Design

4.1 Requirements Analysis Module

The demand analysis module is one of the core components of the digital transformation control system, responsible for collecting and analyzing the various demands faced by enterprises in the process of digital transformation and providing a basis for the subsequent development of transformation strategies and technology selection. Specific functions include.

(1) Enterprise Requirements Collection and Analysis

The system uses automated tools to collect data from different business units, including digital requirements from production, R&D, supply chain, marketing and finance departments. The system also priorities and categories requirements by identifying technology bottlenecks, management pain points and market opportunities in conjunction with the strategic objectives of the business. Prioritization is done using a weighted scoring method based on the company's strategic objectives:

$$P_i = \sum_{j=1}^{m} w_j S_{ij} \tag{1}$$

where P_i is the overall priority of the requirement, w_j is the weight of the requirement evaluation criteria, and S_{ij} is the score of the requirement criteria in the ith item of requirement.

(2) Transformation Strategy Recommendations

Based on the collected demand data, the system will generate personalized digital transformation strategy recommendations through data analysis and artificial intelligence algorithms. These recommendations will provide companies with a full range of solutions, from production line automation to management optimization, to ensure that needs are effectively met during the transformation process.

(3) Visual Requirements Reporting

The Requirements Analysis module will provide visual reports and dashboards to help management quickly understand the current state of requirements and transformation goals, providing a clear basis for subsequent decision-making.

4.2 Technology Selection and Schematic Design Module

The purpose of the technology selection and schematic design module is to select appropriate digital technologies and design specific implementation programs based on the actual needs and strategic objectives of the enterprise. The main functions of this module include:

(1) Technology library management

The module has a rich built-in digital technology library, including industrial Internet, big data analysis, artificial intelligence, Internet of Things, cloud computing, ERP system and other technology solutions. Enterprises can choose the appropriate technology platform and tools according to their own needs.

(2) Technology Selection Tools

This module provides intelligent technology selection tools. Enterprises can enter their needs and goals, and the system will automatically recommend matching technology solutions. The tool will also take into account the enterprise's resource capacity,

budget constraints and technology scalability to help enterprises make more accurate decisions in the technology selection process. Multiple criteria are considered when selecting a technology through the Multi-Criteria Decision Analysis (MCDA) method:

$$Score = \sum_{i=1}^{m} w_i r_{ij} \quad (2)$$

where w_i is the weight of the technology evaluation criteria and r_{ij} is the score of the ith technology under the jth criterion.

(3) Schematic design and optimization

After the technology is selected, the system will design a detailed retrofitting program for the enterprise and provide simulation and optimization tools to assess the feasibility, cost-effectiveness and technology adaptability of the program. The program design not only considers the deployment of the technology, but also includes details at the practical operation level, such as staff training, equipment procurement and timetable.

4.3 Real-Time Monitoring and Evaluation Module

The real-time monitoring and evaluation module is one of the core functions of the control system, responsible for tracking and evaluating the progress of digital transformation, the effect of technology application and business performance in real time. Specific functions include

(1) Real-time data acquisition and monitoring

This module collects real-time data from production lines, R&D, supply chain, finance and other links by integrating IoT devices, sensors, cloud platforms and other technologies. The system is able to automatically monitor key information such as equipment operating status, production progress, quality control and inventory levels, and detect abnormalities in a timely manner.

(2) Performance Assessment and Feedback

Based on real-time data, the system will automatically generate performance assessment reports for various indicators such as production efficiency, product quality, R&D cycle and cost control. At the same time, the system can provide feedback to the enterprise based on the assessment results, suggesting adjustments to the production plan, technology application or management mode.

(3) Visual Monitoring Dashboard

The real-time monitoring and assessment module will provide visual dashboards to show key performance indicators (KPIs) and business health. These dashboards will help management understand how the business transformation process is running in real time and make adjustments and decisions accordingly.

4.4 Decision Support and Optimization Module

The Decision Support and Optimization Module helps companies to make more accurate strategic decisions by providing in-depth analysis and modelling of the collected

data, and to continuously optimize the decisions during the transformation process. The main functions of this module include

(1) Data analysis and modelling

Through big data analysis and artificial intelligence technology, the module is able to comprehensively analyze an enterprise's production data, market demand, financial data and R&D progress. The system is able to discover potential patterns and trends in the data and help enterprises predict future market demand and the direction of technological development.

(2) Decision support system

This module integrates business intelligence (BI) tools to generate decision reports based on analyses to support top management in making strategic decisions. In addition, the system provides decision simulation tools to help enterprises assess the potential risks and rewards of different strategic options, so as to choose the best transformation route. This forecasting model is used to forecast market demand, production and other variables:

$$Y_t = \alpha + \beta_t + \epsilon_t \tag{3}$$

where Y_t is the predicted value at time t, α is the intercept, β_t is the slope, and $\epsilon_t$is the error term.

(3) Optimization Recommendations

Based on the output of the decision support system, the system will automatically give optimization suggestions. In terms of production scheduling, the system can recommend the best resource allocation plan; in the R&D process, the system can optimize the material formula and process flow in a data-driven way to improve R&D efficiency.

4.5 Innovation Incubation and Collaboration Module

The Innovation Incubation and Collaboration Module is designed to support technological innovation and cross-sector and cross-enterprise collaboration to facilitate the continuous introduction of new products and services in the digital transformation process. The key functions of the module include

(1) Innovation Lab Management

The module allows enterprises to create and manage innovation labs to incubate new technologies and products. The module will support processes such as technology development, pilot testing and prototyping to help enterprises accelerate the adoption and commercialization of new technologies.

(2) Cross-sector collaboration platform

This module provides a cross-departmental and cross-enterprise collaboration platform to promote the collaborative work of R&D, production, marketing, finance and other departments. Enterprises can share resources, information and technology through this platform, and promote communication and cooperation between different departments.

(3) Co-operation with Research Institutions

Through cooperation with universities, research institutions and innovative enterprises, Adventure Sailing Enterprises can obtain more technical support and innovative

resources. This module supports enterprises to share R&D data, technological achievements and innovation resources with external partners, and promotes technological joint innovation.

5 Analysis of Application Examples

A new materials company selected as one of the first start-ups, established in 2021 and specializing in the development and production of high-performance composite materials, is currently undergoing a digital transformation to improve its production efficiency, R&D capabilities and market responsiveness. In this case, the adoption of a full lifecycle control system will bring significant improvements and benefits to the business. Table 1 lists the data before and after the implementation of the control method in the digital transformation process of this enterprise, and the results show that the production data of the enterprise after the implementation of the control method is significantly better than that before the implementation. The following is an example of how the enterprise can apply the full life cycle control system of the method:

Table 1. Key benefit indicators before and after the implementation of the full life cycle control system

Indicator	meaning of indicator	pre-implementation	post-implementation	percentage increase/decrease
Productivity (RMB 10,000/person/day)	Measures the value of output created per employee per day. It reflects the efficient use of labor and can be used to assess the effectiveness of production processes.	2.5	3.2	28.00%
Operating Costs (RMB 10,000/day)	Shows the total costs incurred by the organization in its daily operations. It helps to monitor and optimize the use of resources, as well as to assess the effectiveness of operational cost control	150	120	-20.00%
Product upgrade cycle time (days)	The time required to upgrade a product from its initial version to a new or upgraded version. This indicator reflects the speed of product iteration, which is usually related to technological innovation and responsiveness to market needs	180	120	-33.33%
Product Defect Rate Reduction (%)	indicates the percentage reduction in the defect rate during the production process. Reducing the defect rate helps to improve product quality, reduce rework and return costs, and increase customer satisfaction.	5%	6%	24.00%
Energy consumption per unit of output value (10,000 tones of standard coal/ RMB 10,000)	Indicates the amount of energy consumed per unit of output value in the production process, usually measured in tones of standard coal. This indicator helps to measure the energy efficiency of the production process and can be used as a reference for energy saving and emission reduction targets.	0.8	0.6	-25.00%

5.1 Application of the Digital Transformation Planning Module

(1) Enterprise diagnosis and demand analysis

The system first conducts a comprehensive diagnosis of the new material enterprise, analyzing the enterprise's existing production process, R&D management, market layout and financial status. Through data collection and analysis, the system finds that the enterprise has bottlenecks such as unbalanced resource allocation at the technology R&D stage, low degree of automation in the production process, slow market response, and long cycle of transformation of R&D results.

(2) Tailor-made transformation roadmap

In response to these issues, the system has formulated a roadmap for the digital transformation of enterprises, proposing that firstly, intelligent manufacturing upgrades should be implemented to improve the level of automation; secondly, the digital management of R&D should be accelerated, with the introduction of big data and AI technologies to support R&D decision-making; and finally, a cloud-based platform for supply chain collaboration should be constructed to improve the speed of response to the market.

(3) Stage Goal Setting

The system divides the transformation goals into three stages:

Stage 1: Achieve intelligent upgrading of production processes and complete the construction of digital production lines.

Stage 2: Achieve digitalization of the R&D process and use artificial intelligence algorithms to assist in material development.

Stage 3: Build a full-chain supply chain management platform to achieve rapid response to customer demand.

5.2 Resource Integration and Collaborative Management Module Application

(1) External Resource Integration

Through real-time analysis of the market, the system helps new material enterprises to find opportunities to cooperate with top research institutions and obtain more technical support; at the same time, it pushes the relevant government support policies to help enterprises to strive for tax exemptions and R&D financial support.

(2) Cross-sector collaboration

Within the enterprise, the system can help R&D, production, sales and other departments to achieve information sharing and process collaboration. The latest material development progress of the R&D department can be directly synchronized with the production department, which helps the production department to adjust the production line configuration in time to avoid capacity waste.

(3) Resource utilization efficiency analysis

The system monitors the use of production resources (such as equipment use, raw material inventory, etc.) and R&D resources (such as R&D personnel input, laboratory resources, etc.) in real time, and automatically generates a report on the efficiency of resource utilization, which helps the management to identify waste and bottlenecks in time.

5.3 Application of Technology R&D and Innovation Control Module

(1) R&D Progress Monitoring

The system monitors the progress of new material R&D projects by integrating R&D data (e.g., experimental data, production data, market feedback, etc.) and automatically generates R&D progress reports to help management adjust the direction of R&D in a timely manner and ensure that the R&D program is completed on schedule.

(2) Technology Innovation Assessment

The enterprise is developing a new type of high-strength composite material, and the system evaluates the market potential of the technology based on historical data and market demand forecasts. Based on market feedback and peer competition, the system provides the R&D team with suggestions for material performance improvement, cost control and production process optimization to ensure the market adaptability of the technological innovation.

(3) R&D Resource Allocation

When the R&D team encounters technical difficulties, the system can automatically recommend resources from other departments (e.g., production technicians, equipment, etc.) and suggest additional support for key technology R&D personnel to improve R&D efficiency.

5.4 Application of Risk Monitoring and Early Warning Module

(1) Real-time risk monitoring

During the production process, the system will monitor the risk of raw material price fluctuations, especially the supply of certain key raw materials may be affected by policy changes. The system will immediately issue an early warning to remind the purchasing department to make purchasing decisions in advance to ensure supply chain stability.

(2) Risk assessment and early warning

For the research and development stage of new materials, the system predicts the bottlenecks that may be encountered in the process of technology development through big data analysis and provides an early warning of the technical difficulties that may be encountered by the research and development team, prompting the necessity of technology research.

(3) Emergency Response Mechanism

When production quality problems may occur during the material production process, the system can immediately activate the emergency response mechanism, automatically push the relevant operation manual to the production line operator and adjust the production process through automated equipment to prevent the production of poor quality products.

5.5 Application of Data-Driven Decision Support Systems

(1) Global Data Analysis

The system aggregates production, R&D, sales and market data to help management understand the overall operation of the enterprise in real time. By analyzing production line operation data and market sales data, the system can determine whether the market demand for new materials exceeds the production capacity and suggest increasing production or adjusting the production plan.

(2) Technology Trend Forecasting

The system combines the global material science development trend, predicts the future innovations that may overturn the existing material technology, and provides guiding suggestions for the direction of enterprise technology R&D based on the industry's cutting-edge dynamics, so as to ensure that the enterprise R&D always walks in the forefront of technological innovation.

(3) Market and Financial Analysis

Through in-depth analysis of sales data, the system provides management with detailed market forecasts, helps enterprises judge the competitiveness of new materials in different markets, and provides financial forecasts and suggestions for capital allocation.

5.6 Application of Conversion Effectiveness Assessment and Optimization Module

(1) Stage-by-Stage Assessment

The system conducts a staged assessment of the transformation process of the new material enterprise. After the first stage of intelligent manufacturing upgrading, the system evaluates that the production efficiency has increased by 28% and the equipment failure rate has been reduced by 15%. Based on these assessment results, the system provides data support for the digital R&D in the second phase.

(2) Optimization Recommendations

Based on the assessment of the transformation effect, the system makes optimization recommendations to the management. In the second phase, it is necessary to increase the training of R&D staff to improve R&D efficiency. At the same time, it is recommended to reduce production costs by increasing automation to further enhance competitiveness.

(3) Continuous improvement mechanism

The system will summarize the lessons learnt based on the transformation effect of the enterprise at each stage, and continuously improve the transformation strategy through the data feedback mechanism. After discovering that certain aspects (e.g. materials R&D) require stronger market drivers, the system will automatically adjust the direction of R&D to ensure that the enterprise is able to keep up with market demand during the digital transformation process.

5.7 Application Summary

With a full lifecycle control system, enterprises can not only improve productivity and optimize R&D processes, but also better manage external resources and respond to risks. The data-driven decision support and real-time risk monitoring provided by the

system enable enterprises to achieve the desired transformation goals faster and more efficiently in the process of making digital transformation, a high-risk, high-technology investment. At the same time, through continuous evaluation and optimization, it ensures that each stage of the transformation process keeps pace with market demand and technology development trends, thereby enhancing the core competitiveness of the enterprise.

6 Conclusion

The full lifecycle control methodology for digital transformation of Adventure Sailing Enterprises proposed in this paper provides a systematic transformation framework to help Adventure Sailing Enterprises plan, implement, evaluate and optimize efficiently in the transformation process. By establishing a comprehensive technology selection, project implementation, monitoring and evaluation, and innovation support system, the enterprise is able to steadily advance in the complex transformation environment, and ultimately achieve business model innovation and operational efficiency improvement. In the future, with the continuous development of technology and changes in enterprise needs, the methodology and system will continue to be optimized to provide theoretical support and practical guidance for the digital transformation of more enterprises.

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